B.Tech–II Year I Semester

S. No.	Category	Title	L	T	P	Credits
1	BS&H	Discrete Mathematics& Graph Theory	3	0	0	3
2	BS&H	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
3	Engineering Science	Introduction to Data Science	3	0	0	3
4	Professional Core	Advanced Data Structures &Algorithms Analysis	3	0	0	3
5	Professional Core	Object-Oriented Programming Through JAVA	3	0	0	3
6	Professional Core	Data Science Lab	0	0	3	1.5
7	Professional Core	Object-Oriented Programming Through JAVA Lab	0	0	3	1.5
8	Skill Enhancement course	Python programming	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
Total			**15**	**2**	**10**	**20**

B.Tech–II Year II Semester

S. No.	**Category**	**Title**	**L**	**T**	**P**	**Credits**
1	Management Course-I	Optimization Techniques	2	0	0	2
2	Engineering Science/Basic Science	Statistical methods for Data science	3	0	0	3
3	Professional Core	Data Engineering	3	0	0	3
4	Professional Core	DBMS	3	0	0	3
5	Professional Core	Computer Organization And Architecture	3	0	0	3
6	Professional Core	Data Engineering Lab	0	0	3	1.5
7	Professional Core	DBMS Lab	0	0	3	1.5
8	Skill Enhancement course	Exploratory Data Analysis With Python	0	1	2	2
9	BS&H	Design Thinking &Innovation	1	0	2	2
Total			**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation						

II Year I Semester

L	T	P	C
3	0	0	3

DISCRETEMATHEMATICSANDGRAPHTHEORY

Course Objectives:

- To introduce the students to the topics and techniques of discrete methods and combinatorial reasoning.
- To introduce a wide variety of applications. The algorithmic approach to the solution of problems is fundamental in discrete mathematics, and this approach reinforces the close ties between this discipline and the area of computer science.

Course Outcomes: Attend of the course students will be able to

1. Build skills in solving mathematical problems(L3)
2. Comprehend mathematical principles and logic(L4)
3. Demonstrateknowledgeofmathematicalmodelingandproficiencyinusingmathematical software (L6)
4. Manipulate and analyze data numerically and/or graphically using appropriate Software(L3)
5. Howtocommunicateeffectivelymathematicalideas/resultsverballyorinwriting(L1)

UNIT–I: Mathematical Logic:

Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof, Predicate Calculus: Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

UNIT-II: Set Theory:

Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams, Functions: Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties.

UNIT-III: Combinatorics and Recurrence Relations:

Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems.

Recurrence Relations:

Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic

Roots, Solving Inhomogeneous Recurrence Relations

UNIT-IV: Graph Theory:

Basic Concepts, Graph Theory and its Applications, Sub graphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs,

Unit-V: Multi Graphs

Multigraphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

TEXTBOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics-A Computer Oriented Approach, C.L.LiuandD. P.Mohapatra, 3rdEdition, Tata McGraw Hill.
3. Theory and Problems of Discrete Mathematics, Schaum's Outline Series, Seymour Lipschutz and Marc Lars Lipson, 3rd Edition, McGraw Hill.

REFERENCE BOOKS :

1. Discrete Mathematics for Computer Scientists and Mathematicians, J.L.Mott, A.Kandel and T. P. Baker, 2nd Edition, Prentice Hall of India.
2. Discrete Mathematical Structures, Bern and Kolman, RobertC.Busby and Sharon Cutler Ross, PHI.
3. Discrete Mathematics, S.K.Chakraborthy and B.K.Sarkar, Oxford, 2011.
4. DiscreteMathematicsanditsApplicationswithCombinatoricsandGraphTheory, K. H.Rosen, 7thEdition, TataMcGrawHill.

II Year I Semester

L	T	P	C
2	1	0	3

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS'toensuresustainedhappinessandprosperitywhicharethecoreaspirations of all human beings.
- TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslife and profession as well as towards happiness and prosperity based on a correct understandingoftheHumanrealityandtherestofexistence.Suchholistic perspectiveformsthebasisofUniversalHumanValuesandmovementtowards value-based living in a natural way.
- TohighlightplausibleimplicationsofsuchaHolisticunderstandingintermsof ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity(L1, L2)
- Identify one's self, and one's surroundings (family, society nature)(L1, L2)
- Applywhattheyhavelearnttotheirownselfindifferentday-to-daysettingsin real life (L3)
- Relate human values with human relationship and human society.(L4)
- Justify the need for universal human values and harmonious existence(L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in5 modules. The lectures and tutorials are of 1-hourduration.Tutorialsessionsaretobeusedtoexploreandpracticewhathasbeen proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I Introduction to Value Education (6lecturesand3tutorialsforpractice session)

Lecture1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture2: Understanding Value Education

Tutorial1:PracticeSessionPS1SharingaboutOneself

Lecture3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity–the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture12: Programme to ensure self-regulation and Health
Tutorial6:PracticeSessionPS6ExploringHarmonyofselfwiththebody

UNIT III Harmony in the Family and Society (6lecturesand3tutorialsforpractice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture18: Vision for the Universal Human Order
Tutorial9:PracticeSessionPS9ExploringSystemstofulfilHumanGoal

UNIT IV Harmony in the Nature/Existence (4lecturesand2tutorialsforpractice session)
Lecture19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture22: The Holistic Perception of Harmony in Existence
Tutorial11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V Implications of the Holistic Understanding –a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial12:PracticeSessionPS12ExploringEthicalHumanConduct
Lecture25:A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial14:PracticeSessionPS14ExploringStepsofTransitiontowardsUniversal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8ExploringtheFeelingofRespect
PS9ExploringSystemstofulfilHumanGoal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11ExploringCo-existenceinExistence

PracticeSessionsforUNITV–ImplicationsoftheHolisticUnderstanding–aLookatProfessional Ethics
PS12ExploringEthicalHumanConduct
PS13ExploringHumanisticModelsinEducation
PS14ExploringStepsofTransitiontowardsUniversalHumanOrder

READINGS:

Text book and Teachers Manual

a. The Text book

R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and ProfessionalEthics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria, *Teachers' Manual for A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. *Jeevan Vidya: EkParichaya*, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. *HumanValues*, A.N.Tripathi, NewAgeIntl.Publishers, NewDelhi, 2004.
3. *TheStoryofStuff*(Book).
4. *TheStoryofMyExperimentswithTruth*-byMohandasKaramchandGandhi
5. *SmallisBeautiful*-E.FSchumacher.
6. *SlowisBeautifu*l-CecileAndrews
7. *EconomyofPermanence*-JCKumarappa
8. *BharatMeinAngrejiRaj*–PanditSunderlal
9. *RediscoveringIndia*-byDharampal
10. *HindSwarajorIndianHomeRule*-byMohandasK.Gandhi
11. *IndiaWinsFreedom*-MaulanaAbdulKalamAzad
12. *Vivekananda*-RomainRolland(English)
13. *Gandhi*-RomainRolland(English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, work sheets, home assignment and/or activity are included.

The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, Without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

II Year I Semester

L	T	P	C
3	0	0	3

INTRODUCTIONTODATASCIENCE

COURSE OBJECTIVES: From the course the student will learn

1. Knowledge and expertise to become a data scientist.
2. Essential concepts of statistics and machine learning that are vital for data science;
3. Significance of exploratory data analysis (EDA) in data science.
4. Critically evaluate data visualizations presented on the dashboards
5. Suitabilityandlimitationsoftoolsandtechniquesrelatedtodatascienceprocess

UNITI: Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science

Data Science process: Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them

Unit II: Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modeling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning

Handling large data: problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

UNITIII: NoSQL movement for handling Big data: Distributing data storage and processing with Hadoop frame work, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling

UNITIV: Tools and Applications of Data Science: Introducing **Neo4j** for dealing with graph databases, graph query language **Cypher**, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts

UNIT V: Data Visualization and Prototype Application Development: Data Visualization options, Cross filter, the Java Script Map Reduce library, creating an interactive dash board with dc.js, Dashboard development tools.

Applying the Data Science process for real world problem solving scenarios as a detailed case study.

Textbook:

1) Davy Cielen, ArnoD.B.Meysman, and Mohamed Ali, "Introducing to Data Science using Python tools", Manning Publications Co, Dream tech press, 2016
2) Prateek Gupta, "Data Science with Jupyter" BPB publishers, 2019forbasics

Reference Books:

1) Joel Grus, "Data Science From Scratch", OReilly, 2019
2) Doing Data Science: Straight Talk From The Frontline, 1stEdition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013

II Year I Semester

L	T	P	C
3	0	0	3

ADVANCED DATASTRUCTURES & ALGORITHM ANALYSIS

Course Objectives:

The main objectives of the course is to

- provide knowledge on advance data structures frequently used in Computer Science domain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

UNIT–I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.
AVL Trees – Creation, Insertion, Deletion operations and Applications
B-Trees – Creation, Insertion, Deletion operations and Applications

UNIT–II:

Heap Trees (Priority Queues)–Min and Max Heaps, Operations and Applications
Graphs–Terminology, Representations, Basic Search and Traversals, Connected Components and Bi connected Components, applications
Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

UNIT–III:

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths
Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths – General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

UNIT–IV:

Back tracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem
Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem

UNIT–V:

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem
NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP)
NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Textbooks:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press
2. Computer Algorithms /C++ Ellis Horowitz, Sartaj Sahni, SanguthevarRajasekaran2ndEdition University Press

Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C&C++: Langsam, Augenstein & Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs: N.Wirth, PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni & Mehta, Galgottia Pub.
7. Data structures in Java, Thomas Standish, Pearson Education Asia

Online Learning Resources:

1. https://www.tutorialspoint.com/advanced_data_structures/index.asp
2. http://peterindia.net/Algorithms.html
3. Abdul Bari, 1.IntroductiontoAlgorithms(youtube.com)

II Year I Semester

L	T	P	C
3	0	0	3

OBJECT-ORIENTED PROGRAMMING THROUGH JAVA

Course Objectives:

The learning objectives of this course are to:

- IdentifyJavalanguagecomponentsandhowtheyworktogetherinapplications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- LearnhowtoextendJavaclasseswithinheritanceanddynamicbindingandhowto use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

UNIT I: Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II: Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III: Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for

Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNITI IV: Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-un boxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Key words throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

UNIT V: String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Dead lock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity: Introduction, JDBC Architecture, Installing My SQL and My SQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:

1. The complete Reference Java, 11th edition, Herbert Schildt, TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

II Year I Semester

L	T	P	C
0	0	3	1.5

DATA SCIENCE LAB

Course Objectives:

- The main objective of the course is to inculcate the basic understanding of Data Science and its practical implementation using Python.

List of Experiments

1. Creating a NumPy Array
   a. Basic nd array
   b. Array of zeros
   c. Array of ones
   d. Random numbers in nd array
   e. An array of your choice
   f. I matrix in NumPy
   g. Evenly spaced nd array
2. The Shape and Reshaping of NumPy Array
   a. Dimensions of NumPy array
   b. Shape of NumPy array
   c. Size of NumPy array
   d. Reshaping a NumPy array
   e. Flattening a NumPy array
   f. Transpose of a NumPy array
3. Expanding and Squeezing a NumPy Array
   a. Expanding a NumPy array
   b. Squeezing a NumPy array
   c. Sorting in NumPy Arrays
4. Indexing and Slicing of NumPy Array
   a. Slicing1-DNumPyarrays
   b. Slicing2-DNumPyarrays
   c. Slicing3-DNumPyarrays
   d. Negative slicing of NumPy arrays
5. Stacking and Concatenating Numpy Arrays
   a. Stacking nd arrays
   b. Concatenating nd arrays
   c. Broadcasting in Numpy Arrays
6. Perform following operations using pandas
   a. Creating data frame
   b. concat()
   c. Setting conditions
   d. Adding a new column
7. Perform following operations using pandas

a. Filling NaN with string
b. Sorting based on column values
c. groupby()

8. Read the following file formats using pandas
   a. Text files
   b. CSV files
   c. Excel files
   d. JSON files
9. Read the following file formats
   a. Pickle files
   b. Image files using PIL
   c. Multiple files using Glob
   d. Importing data from database
10. Demonstrate web scraping using python
11. Perform following preprocessing techniques on loan prediction dataset
    a. Feature Scaling
    b. Feature Standardization
    c. Label Encoding
    d. One Hot Encoding
12. Perform following visualizations using mat plot lib
    a. Bar Graph
    b. Pie Chart
    c. Box Plot
    d. Histogram
    e. Line Chart and Subplots
    f. Scatter Plot
13. Getting started with NLTK, install NLTK using PIP
14. Python program to implement with Python SciKit-Learn & NLTK
15. Python program to implement with Python NLTK/Spicy/PyNLPI.

Web References:

1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/
2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/
3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/
4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/
5. https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/6.
6. https://www.nltk.org/book/ch01.html

II Year I Semester

L	T	P	C
0	0	3	1.5

OBJECT-ORIENTED PROGRAMMING THROUGH JAVA LAB

Course Objectives:

The aim of this course is to

- Practice object oriented programming in the Java programming language
- implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FXGUI

Experiments covering the Topics:

- Object Oriented Programming fundamentals-data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, Java FXGUI

Sample Experiments:

Exercise–1:

a) Write a java program to display default value of all primitive data type of JAVA

b) Write a java program that display the roots of a quadratic equation $ax^2+bx=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.

Exercise-2

a) Write a java program to search for an element in a given list of elements using binary search mechanism.

b) Write a JAVA program to sort for an element in a given list of elements using bubble sort

c) Write a JAVA program using String Buffer to delete, remove character.

Exercise-3

a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.

b) Write a JAVA program implement method overloading.

c) Write a JAVA program to implement constructor.

d) Write a JAVA program to implement constructor overloading.

Exercise-4

a) Write a JAVA program to implement Single Inheritance

b) Write a JAVA program to implement multi level Inheritance

c) Write a JAVA program for abstract class to find areas of different shapes

Exercise-5

a) Write a JAVA program give example for "super" keyword.

b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

c) Write a JAVA program that implements Runtime polymorphism

Exercise-6

a) Write a JAVA program that describes exception handling mechanism

b) Write a JAVA program Illustrating Multiple catch clauses

- Write a JAVA program for creation of Java Built-in Exceptions
- Write a JAVA program for creation of User Defined Exception

Exercise-7

a) Write a JAVA program that creates threads by extending Thread class. First thread display "GoodMorning"every1sec, the second thread displays "Hello" every 2 seconds and the third display "Welcome" every 3 seconds, (Repeat the same by implementing Runnable)

b) Write a program illustrating **isAlive** and **join()**

c) Write a Program illustrating Daemon Threads.

d) Write a JAVA program Producer Consumer Problem

Exercise–8

1. Write a JAVA program that import and use the user defined packages
2. Without writing any code, build a GUI that display text in label and image in an Image View (use Java FX)
3. Build a Tip Calculator app using several Java FX components and learn how to respond to user interactions with the GUI

Exercise–9

1. Write a JAVA program that connects to a database using JDBC

b) Write a java program to connect to a data base using JDBC and insert values into it.

c) Write a java program to connect to a data base using JDBC and delete values from it

L	T	P	C
0	1	2	2

II Year I Semester

PYTHON PROGRAMMING

(Skill Enhancement Course)

Course Objectives:

The main objectives of the course are to

a. Introduce core programming concepts of Python programming language.
b. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
c. Implement Functions, Modules and Regular Expressions in Python programming and to create practical and contemporary applications using these

UNTI-I: History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupiter Notebook.
Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.
Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bitwise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II: Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.
Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.
Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, Del Statement.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:
   i. Addition ii. Insertion iii. slicing
6. Write a program toperformany5built-infunctionsbytakinganylist.

UNIT-III: Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.
Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip()Function, Sets, Set Methods, Frozen set.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. Write a program to sum all the items in a given dictionary.

UNIT-IV: Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.
Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.

6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V: Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python program to demonstrate NumPy arrays creation using array ()function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
    a) Apply head() function to the pandas data frame
    b) Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowri Shankar S, Veena A., Introduction to Python programming, CRC Press.
2. Python programming, S Sridhar, J Indumathi, VM Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources / Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

II Year I Semester

L	T	P	C
2	0	0	0

ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

Course Outcomes:

- Grasp multidisciplinary nature of environmental studies and various renewable and non-renewable resources.
- Understand flow and bio-geo-chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, water shed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

UNIT–I

Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams–benefits and problems–Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies–Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.– Energy resources:

UNIT–II

Ecosystems: Concept of an ecosystem.–Structure and function of an ecosystem–Producers, consumersanddecomposers–Energyflowintheecosystem–Ecologicalsuccession– Food chains, food webs and ecological pyramids–Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grass land ecosystem
c. Desert ecosystem
d. Aquatic ecosystems(ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation: Introduction Definition: genetic, species and ecosystem

diversity–Bio-geo graphical classification of India–Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values–Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life conflicts–Endangered and endemic species of India –Conservation of bio diversity: In-situ and Ex-situ conservation of biodiversity.

UNIT–III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT–IV

Social Issues and the Environment: From Unsustainable to Sustainable development–Urban problems related to energy – Water conservation, rain water harvesting, water shed management –Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions–Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wastelandreclamation.–Consumerismandwasteproducts.–EnvironmentProtection Act. – Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act– Wild life Protection Act–Forest Conservation Act–Issues involved in enforcement of environmental legislation–Public awareness.

UNIT–V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education–HIV/AIDS–Women and Child Welfare–Role of information Technology in Environment and human health–Case studies. Field Work: Visit to a local area to document environmental assets River/ forest grassland/ hill/ mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds–river, hills lopes, etc..

Textbooks:

1. Text book of Environmental Studies for Undergraduate Courses ErachBharucha for University Grants Commission, Universities Press.

2. Palani swamy, "Environmental Studies", Pearson education
3. S.AzeemUnnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt.Ltd.

Reference Books :

1. Deeksha Dave and E.Sai Baba Reddy, "Text book of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J.GlynnHenryandGaryW.Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M.Masters and WendellP.Ela, "Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

II Year II Semester

L	T	P	C
3	0	0	3

OPTIMIZATION TECHNIQUES

Pre-requisite:

Course Objectives:

1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
2. To state single variable and multi variable optimization problems, With out and with constraints.
3. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
4. To state transportation and assignment problem as a linear programming problem to determine Simplex method.
5. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.

Course Outcomes: At the end of the course, student will be able to

- State and formulate the optimization problem, With out and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Apply and Solve transportation and assignment problem by using Linear programming Simplex method.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

UNITI: Introduction and Classical Optimization Techniques:
Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.
Classical Optimization Techniques: Single variable Optimization, multi variable Optimization Without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lag range multipliers, multivariable Optimization within quality constraints, Kuhn – Tucker conditions

UNITII: Linear Programming:
Standard form of a linear programming problem, geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm.

UNITIII: Transportation Problem:

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method, testing for optimality of balanced transportation problems, Special cases in transportation problem.

UNITIV: Nonlinear Programming:

Unconstrained cases, one – dimensional minimization methods: Classification, Fibonacci method, Univariate method, steepest descent method. Constrained cases– Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method, Basic approaches of Interior and Exterior penalty function methods,

UNITV: Dynamic Programming:

Dynamic Programming multistage decision processes, types, concept of sub optimization and the principle of optimality, computational procedure in dynamic Programming, examples illustrating the calculus method of solution, examples illustrating the tabular method of solution.

Textbooks:

1. "Engineering optimization: Theory and practice", S.S.Rao, New Age International (P)Limited, 3rdedition, 1998.
2. "Introductory Operations Research", H.S. Kasene& K.D. Kumar, Springer (India), Pvt.LTd.

Reference Books :

1. "Optimization Methods in Operations Research and systems Analysis", by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research, Dr.S.D.Sharma, Kedarnath, Ramnath&Co

II Year II Semester

L	T	P	C
3	0	0	3

STATISTICAL METHODS FOR DATA SCIENCE

Pre-requisite:

Course Objectives: This course aims at providing knowledge on basic concepts of Statistics, Estimation and testing of hypotheses for large and small samples**.**

Course Outcomes: Student will be able to

1. Analyzedataanddrawconclusionaboutcollectionofdataandfittingofdistributions
2. Analyzing the testing of hypothesis for Large and Small samples.
3. Develop skills in problem solving of the regression analysis
4. Understanding the significance of Time Series data in various fields
5. Understanding the classification using Logistic Regression

UNIT–I: Data Visualization and Distributions

Data Visualization Techniques: Introduction to Statistical methods-Exploratory Data Analysis-Charts (Line, Pie, Bar); Plots (Bubble, Scatter); Maps (Heat, Dot Distribution); Diagrams (Trees and Matrices)-Principal Components Analysis

Introduction to Data Distributions - Probability Distributions – discrete (binomial, Poisson), Continuous Distributions (Normal, exponential).

UNIT–II: Hypothesis Testing

IntroductiontoParametricEstimation-ParametricConfidenceIntervals

Choosing a Statistic - Hypothesis Testing - Parametric test: the T-test - Applications to Hypothesis Tests-Pair wise comparisons.

UNIT-III: Linear Regression and Multiple Regression

Regression: Linear Regression, Curvi linear Regression: Exponential Regression- Polynomial Regression- Power Model.

Practical Examples - The nature of the 'relationship' - Multiple Linear Regression - Important measurements of the regression estimate - Multiple Regression with Categorical Explanatory Variables - Inference in Multiple Regression - Variable Selection.

UNIT-IV: Time Series

Time series: Significance of Time series analysis, Components of Time series, Secular trend: Graphic method, Semi-average method, Method of moving averages, Method of least squares :straight line and non-linear trends, Logarithmic methods–Exponential trends, Growth curves, Seasonal Variations: Method of simple averages, Ratio-to-trend method, ratio-to-moving average method, Link relative method.

(Text book: K.Murugesan, P.Gurusamy , "Probability, Statistics and Random Processes"**)**

UNIT-V: Logistic Regression

The classification problem-Logistic Regression Setup-Interpreting the Results- Comparing Models - Classification Using Logistic Regression.

Textbooks:

1. Elizabeth Purdom, "Statistical methods for Data science"
2. K.Murugesan, P.Gurusamy, “Probability, Statistics and Random Processes”

Reference Books :

1. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference– Testing of Hypotheses, Prentice Hall of India, 2014.
2. Robert V Hogg, Elliot A Tannis and Dale L.Zimmer man, Probability and Statistical Inference, 9thedition, Pearson publishers, 2013.
3. Chris Chatfield, “The analysis of time series an introduction, ” 5th edition, Chapman & Hall/CRC.
4. Peter J. Brockwell, Richard A.Davis, “Introduction to Time series and Forecasting, ” Second edition, Springer.

Online Learning Resources: epurdom.github.io/Stat131A/Rsupport/index.html.

II Year II Semester

L	T	P	C
3	0	0	3

DATA ENGINEERING

Course Objectives:

- Explain basic concepts of Data Engineering
- Discuss about Data Engineering Life Cycle
- How to design Good Data Architecture

UNIT-I: Introduction to Data Engineering: Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities,

Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles.

UNIT-II: Data Engineering Life Cycle: Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data.

Major under currents across the Data Engineering Life Cycle: Security, Data Management, Data Ops, Data Architecture, Orchestration, Software Engineering.

UNIT-III: Designing Good Data Architecture: Enterprise Architecture, Data Architecture**,** Principles of Good Data Architecture, Major Architecture Concepts.

Data Generation in Source Systems: Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details.

UNIT-IV: Storage: Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lake house.

Ingestion: Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data

UNIT-V: Queries, Modeling and Transformation: Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modeling, Modeling Streaming Data, Transformations, Streaming Transformations and Processing.

Serving Data for Analytics, Machine Learning and Reverse ETL: General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL.

Text Books:

1. JoeReis, MattHousley, Fundamentals of Data Engineering, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

Reference Books :

1. Paul Crickard, Data Engineering with Python, Packt Publishing, October2020.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013
3. James Dens more, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

II Year II Semester

L	T	P	C
3	0	0	3

DATA BASE MANAGEMENT SYSTEMS

Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Data base language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Data base indexing techniques and storage techniques

UNITI: Introduction: Data base system, Characteristics (Data base Vs File System), Data base Users, Advantages of Data base systems, Data base applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.
Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Unit II: Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT III: SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.

UNIT IV: Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNITV: Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for

Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.
Introduction to Indexing Techniques: B+ Trees, operations on B+ Trees, Hash Based Indexing:

Text Books:

1) Database Management Systems, 3rdedition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2) Database System Concepts, 5thedition, Silberschatz, Korth, Sudarsan, TMH(For Chapter 1 and Chapter 5)

Reference Books:

1. Introduction to Database Systems, 8thedition, CJDate, Pearson.
2. Database Management System, 6thedition, Ramez Elmasri, Shamkant B.Navathe, Pearson
3. DatabasePrinciplesFundamentalsofDesignImplementationandManagement, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Web-Resources:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672820224556_shared/overview

II Year II Semester

L	T	P	C
3	0	0	3

COMPUTER ORGANIZATION AND ARCHITECTURE

Course Objectives:

The purpose of the course is

- Discuss about principles of computer organization and the basic architectural concepts.
- Explain in depth understanding of basic organization, design, Programming of a simple digital computer, computer arithmetic, instruction set design, micro programmed control unit, pipelining and vector processing, memory organization and I/O systems.

UNIT I: Digital Computers and Data Representation: Introduction, Numbering Systems, Decimal to Binary Conversion, Binary Coded Decimal Numbers, Weighted Codes, Self-Complementing Codes, Cyclic Codes, Error Detecting Codes, Error Correcting Codes, Hamming Code for Error Correction, Alphanumeric Codes, ASCI Code

Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.

Boolean Algebra and Logical gates: Boolean Algebra: Theorems and properties, Boolean functions, canonical and standard forms, minimization of Boolean functions using algebraic identities; Karnaugh map representation and minimization using two and three variable Maps ; Logical gates, universal gates and Two- level realizations using gates: AND-OR, OR-AND, NAND-NAND and NOR-NOR structures

UNIT II: Digital logic circuits: Combinatorial Circuits: Introduction, Combinatorial Circuit Design Procedure, Implementation using universal gates, Multi-bit adder, Multiplexers, De-multiplexers, Decoders

Sequential Switching Circuits: Latches and Flip-Flops, Ripple counters using T flip-flops; **Synchronous counters**: Shift Registers; Ring counters

UNIT III: Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Booth multiplication algorithm, Division Algorithms, Floating – point Arithmetic Operations.

Register Transfer language and micro instructions: Bus memory transfer, arithmetic and logical micro-operations, shift and rotate micro-operations

Basic Computer Organization and Design: Stored program concept, computer Registers, common bus system, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input–Output configuration and program Interrupt.

UNIT IV: Micro programmed Control: Control memory, Address sequencing, micro program example, design of control unit.
Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation
Program Control: conditional Flags and Branching

UNITV: Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.
Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

Text Books:

1. Digital Logic and Computer Design, Moriss Mano, 11thEdition, Pearson.
2. Computer System Architecture, 3rdEdition, M.Morris Mano, PHI

Reference Books:

1. Digital Logic and Computer Organization, Rajaraman, Radhakrishnan, PHI, 2006
2. Computer Organization, 5ThEdition, Hamacher, Vranesic, Zaky, TMH, 2002
3. Computer Organization & Architecture: Designing for Performance, 7th Edition, William Stallings, PHI, 2006

II Year II Semester

L	T	P	C
0	0	3	1.5

DATA ENGINEERING LAB

Course Objective:

- The main objective of this course is to teach how build data engineering infrastructure and data pipelines.

Course Outcomes:

At the end of the course student will be able to:

1. Build our Data Engineering Infrastructure
2. Demonstrate Reading and Writing files
3. Build Data Pipelines and integrate with Dashboard
4. Deploy the Data Pipeline in production

Experiments:

1. Installing and configuring Apache NiFi, Apache Airflow
2. Installing and configuring Elastic search, Kibana, Postgre SQL, pgAdmin4
3. Reading and Writing files
    a. Reading and writing files in Python
    b. Processing files in Air flow
    c. NiFi processors for handling files
    d. Reading and writing data to databases in Python
    e. Databases in Airflow
    f. Database processors in NiFi
4. Working with Databases
    a. Inserting and extracting relational data in Python
    b. Inserting and extracting NoSQL database data in Python
    c. Building database pipelines in Airflow
    d. Building database pipelines in NiFi
5. Cleaning, Transforming and Enriching Data
    a. Performing exploratory data analysis in Python
    b. Handling common data issues using pandas
    c. Cleaning data using Airflow
6. Building the Data Pipeline
7. Building a Kibana Dash Board
8. Perform the following operations
    a. Staging and validating data
    b. Building idempotent Data Pipelines
    c. Building atomic Data Pipelines
9. Version Control with the NiFi Registry

a. Installing and configuring the NiFi Registry
b. Using the Registry in NiFi
c. Versioning your Data Pipelines
d. Using git-persistence with the NiFi Registry

10. Monitoring Data Pipelines
    a. Monitoring NiFi in the GUI
    b. Monitoring NiFi using processors
    c. Monitoring NiFi with Python and the RESTAPI
11. Deploying Data Pipelines
    a. Finalizing your data pipelines for production
    b. Using the NiFi variable registry
    c. Deploying your data pipelines
12. Building a Production Data Pipeline
    a. Creating a test and production environment
    b. Building a production data pipeline
    c. Deploying a data pipe line in production

Reference Books:

1. Paul Crickard, Data Engineering with Python, Packt Publishing, October2020.

II Year II Semester

L	T	P	C
0	0	3	1.5

DATABASE MANAGEMENT SYSTEMS LAB

Course Objectives:

This Course will enable students to

- Populate and query a database using SQLDDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers,

Experiments covering the topics:

- DDL, DML, DCL commands
- Queries, nested queries, built-in functions,
- PL/SQL Programming-control structures
- Procedures, Functions, Cursors, Triggers,
- Database connectivity-ODBC/JDBC

Sample Experiments:

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSET, Constraints. Example: - Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)
5.
   i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
   ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.

6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FORUPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Createatableandperformthesearchoperationontableusingindexingandnon-indexing techniques.
13. Write a java program that connects to a database using JDBC
14. Write a java program to connect to a data base using JDBC and insert values into it
15. Write a java program to connect to a database using JDBC and delete values from it

Text Books / Suggested Reading:

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007

II Year II Semester

L	T	P	C
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EXPLORATORY DATA ANALYSIS USING PYTHON (SKILL DEVELOPMENT COURSE)

Course Objectives:

1. This course introduces the fundamentals of Exploratory Data Analysis
2. Itcoversessentialexploratorytechniquesforunderstandingmultivariatedataby summarizing it through statistical methods and graphical methods.

Course Outcomes:

1. Enumerate the fundamentals of Exploratory Data Analysis.
2. Visualize the data using basic graphs and plots.
3. Apply different Data Transformation Techniques.
4. Summarize the data using descriptive statistics.
5. Evaluate the Models and select the best model

UNIT-I

Exploratory Data Analysis Fundamentals: Understanding data science, The significance of EDA, Steps in EDA, Making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, Getting started with EDA.

Sample Experiments:

1. a) Download Dataset from Kaggle using the following link : https://www.kaggle.com/datasets/sukhmanibedi/cars4u
   b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib, sea born)
2. PerformNumpyArraybasicoperationsandExploreNumpyBuilt-infunctions.
3. Loading Dataset into pandas data frame
4. Selecting rows and columns in the data frame

UNIT-II

Visual Aids for EDA: Technical requirements, Line chart, Bar charts, Scatter plot using sea born, Polar chart, Histogram, Choosing the best chart

Case Study: EDA with Personal Email, Technical requirements, loading the dataset, Data transformation, Data cleansing, applying descriptive statistics, Data refactoring, Data analysis.

Sample Experiments:

1. Apply different visualization techniques using sample dataset
2. Line Chart b)Bar Chart c)Scatter Plots d)Bubble Plot
3. Generate Scatter Plot using sea born library for iris dataset
4. Apply following visualization Techniques for a sample dataset

a) Area Plot b)Stacked Plot c)Pie chart d)Table Chart

5. Generate the following charts for a dataset.
a) Polar Chart b)Histogram c)Lollipop chart
6. Case Study: Perform Exploratory Data Analysis with Personal Email Data

UNIT-III

Data Transformation: Merging database-style data frames, Concatenating along with an axis, Merging on index, Reshaping and pivoting, Transformation techniques, Handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.

Sample Experiments:

1. Perform the following operations
   a) Merging Data frames
   b) Reshaping with Hierarchical Indexing
   c) Data Deduplication
   d) Replacing Values
2. Apply different Missing Data handling techniques
   a) NaN values in mathematical Operations
   b) Filling in missing data
   c) Forward and Backward filling of missing values
   d) Filling with index values
   e) Interpolation of missing values
3. Apply different data transformation techniques
   a) Renaming axis indexes
   b)Discretization and Binning
   c) Permutation and Random Sampling
   d) Dummy variables

UNIT-IV

Descriptive Statistics: Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtosis, Calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis

Sample Experiments:

1. Study the following Distribution Techniques on a sample data
   a) Uniform Distribution
   b) Normal Distribution
   c) Gamma Distribution
   d) Exponential Distribution
   e) Poisson Distribution
   f) Binomial Distribution
2. Perform Data Cleaning on a sample dataset.
3. Compute measure of Central Tendency on a sample dataset
   a) Mean b)Median c)Mode
4. Explore Measures of Dispersion on a sample dataset

a) Variance b)Standard Deviation c)Skewness d)Kurtosis

5. a)Calculating percentiles on sample dataset
   b) Calculate Inter Quartile Range(IQR) and Visualize using Box Plots
6. Perform the following analysis on automobile dataset.
   a) Bivariate analysis b)Multi variate analysis
7. Perform Time Series Analysis on Open Power systems dataset

UNIT-V Model Development and Evaluation: Data Storage Sample Experiments**:**

1. Perform hypothesis testing using stats models library
   a) Z-Test b)T-Test
2. Develop model and Perform Model Evaluation using different metrics such as prediction score, R2 Score, MAE Score, and MSE Score.

22. Case Study: Perform Exploratory Data Analysis with Wine Quality Dataset

Text Book:

1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020.

References:

1. Ronald K.Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. Radhika Datar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, Ist Edition, Packt Publishing, 2019

Web References:

1. https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python
2. https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-data-analysis-eda-using-python/#h-conclusion
3. https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook

II Year II Semester

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DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert in to demand.
- Introduce product planning and product development process.

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in Various sectors.	L3
CO4	Analyze to work in a multi disciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5

UNIT–I Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT-II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT-III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT-IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT–V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Class room, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lid well, Kritina Holden, & Jill butter, Universal principles of design, 2/e, Rock port Publishers, 2010.
4. Ches brough.H, the era of open innovation, 2003.

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview